

From IoT to Digital Twins

Presentation to École des Mines de
Saint-Étienne

26/11/2020

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Agenda

Orange at a glance

Research by Orange

Orange view of IoT

Beyond the IoT with Digital Twins: Thing in the future

Demonstration

Orange at a glance



Our purpose

As a trusted partner, Orange gives everyone the keys to a responsible digital world.

A global Group

26 countries
in the world and a global
presence with Orange
Business Services

147,000
employees

8th
global telecommunications
brand

266
million customers
worldwide

5,169
shops around the world

1,320
smart stores



Orange at a glance

4 activities



**Augmented connectivity
(retail, business,
wholesale)**



Cybersecurity



Business IT support services



Financial services

€42.2

billion in revenues

€13

billion EBITDAaL from
telecoms activities

€7.3

billion in investments

€672

million invested in
Research & Innovation

N°1

in fixed-mobile
convergence in Europe

450,000

km of submarine cables

1,200

cybersecurity experts

Orange
Cyberdefense

18

million active customers
in MEA

Orange
Money

580,000

customers



82.2 %

of electrical and electronic
equipment waste recovered
at Group level

5.4 %

reduction in Co₂
emissions between 2018
and 2019

€23

million Foundation
funding, in particular to
disadvantaged young
people and women

Research by Orange





“Research at Orange lies at the heart of a remarkable history of innovation.

In a world that is changing faster than ever, it is essential that we continue to consider the future.

This is the mission that I have set for our Research team.”

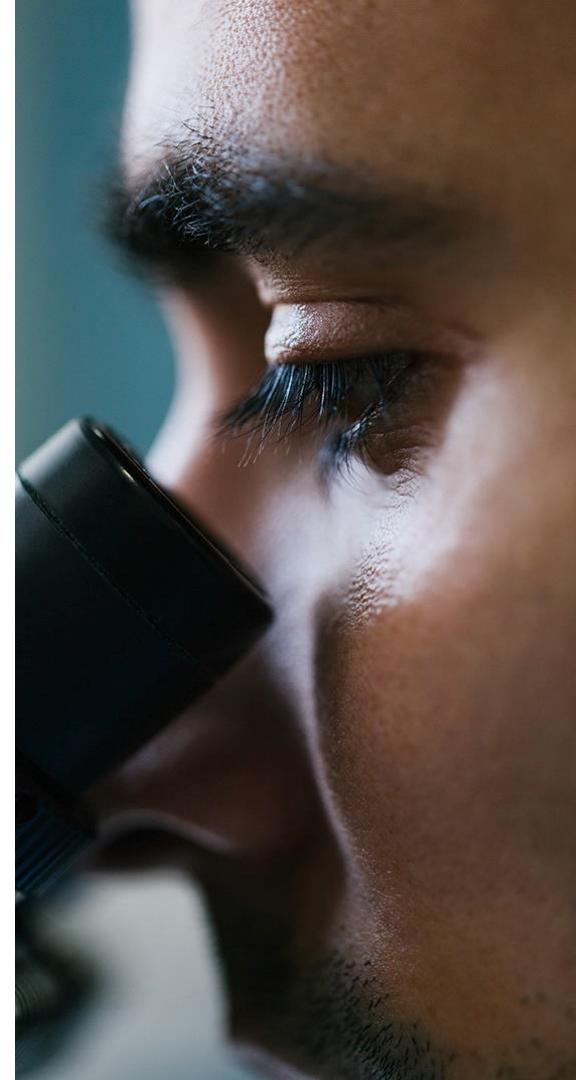
Stéphane Richard,
CEO

Open, influential and pioneering research

Light up the future, identify risks and breakthrough innovations, explore and build opportunities, influence our ecosystems

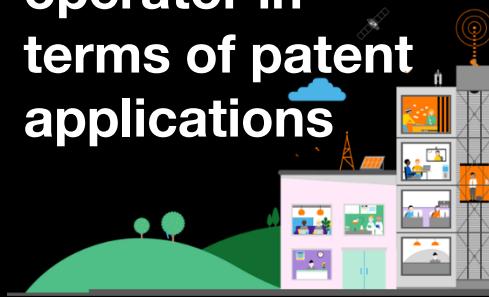
Build strategic assets, skills, intellectual property, standards and partnerships

Sustain innovation for our products and services, while continuing to improve the efficiency of our infrastructures



No. 1

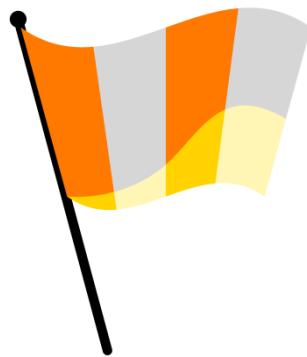
European operator in terms of patent applications



600 researchers



220 patents filed in 2018



Our research in numbers

140 PhDs / post-doctorates

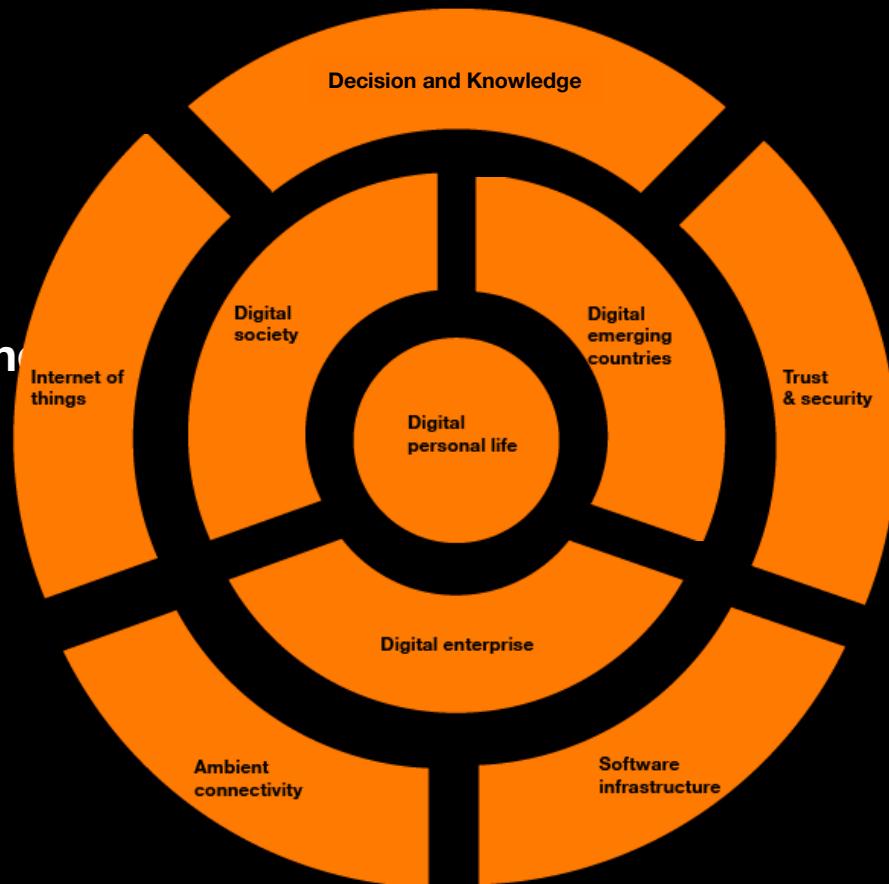


100 partnerships (labs, collaborative projects, tech research labs, etc.)



9 research domains

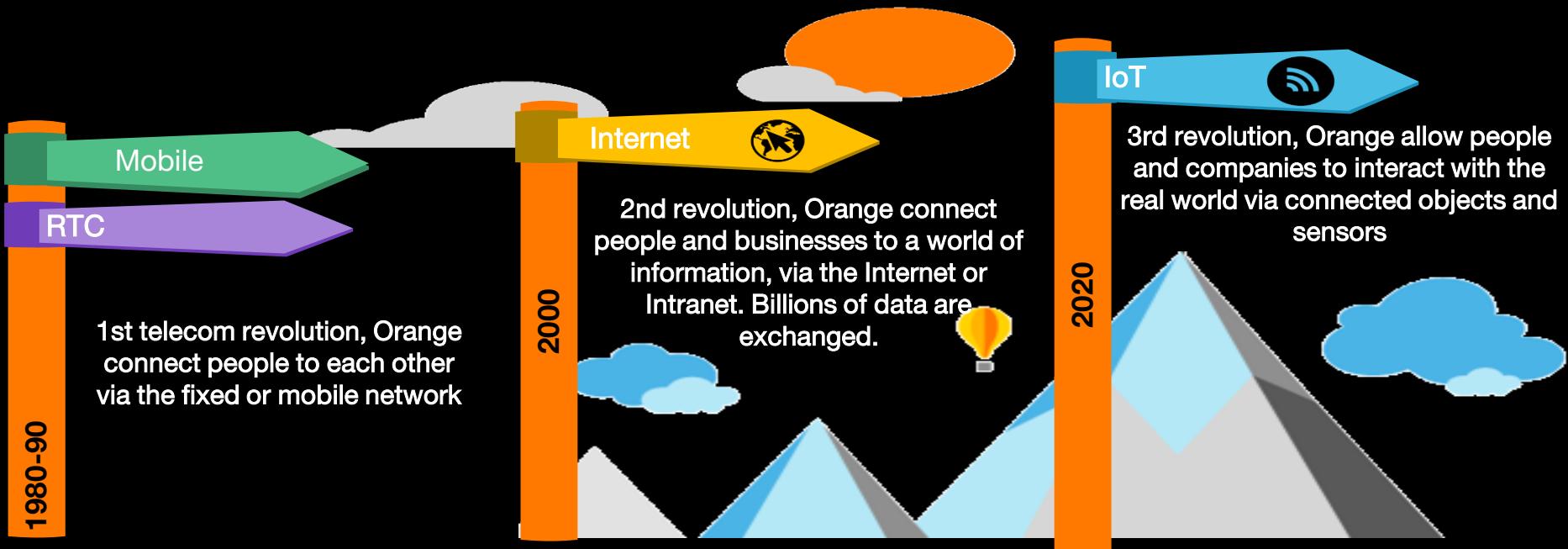
- support the **Engage 2025** strategy and beyond
- drive our research investments
- **explore changes in technology, usage and economic models**
 - via open and modular research platforms integrating technology and usage through future experiences
 - by collaborating in 360 ° research covering technology, IT, UX, eco-tech, legal, marketing skills, etc.



The Orange view of IoT



IoT is part of our core operator activities

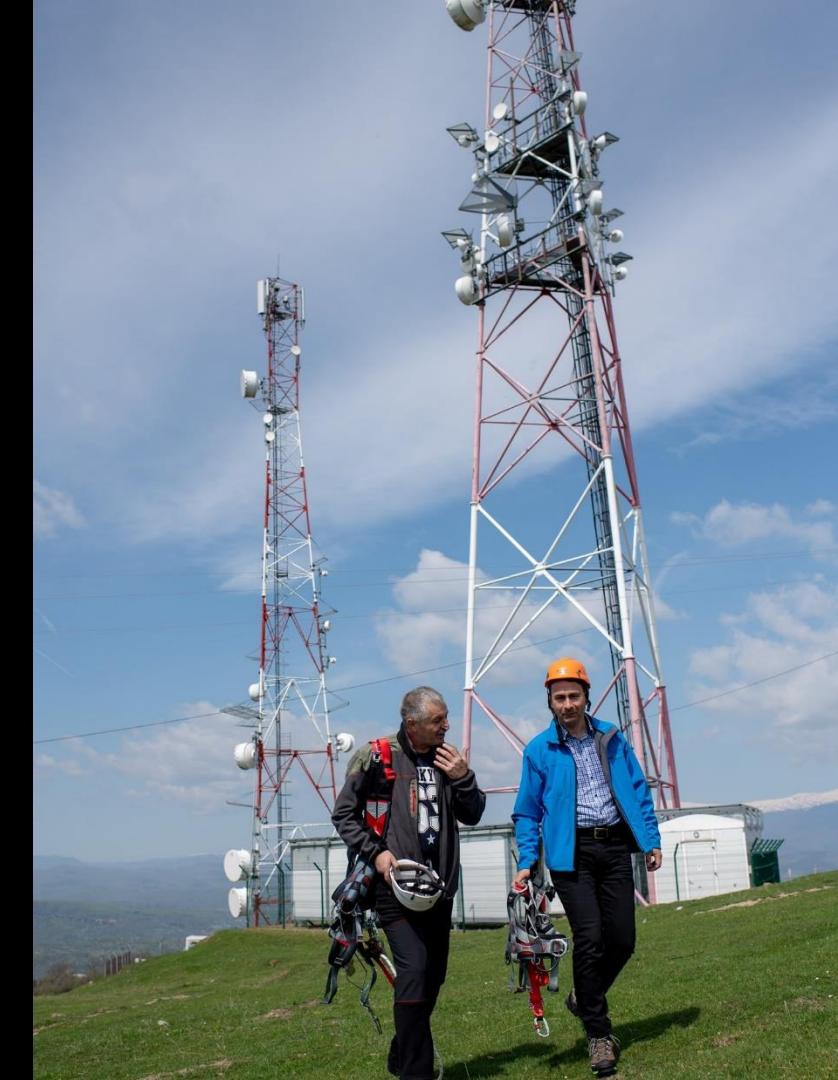


Six key verticals

B2B verticals
B2C verticals



Connectivity



To address a variety of use cases, Orange offers a portfolio of complementary technologies



#1 in Europe
for M2M
connectivity

Mobile 2G, 3G, 4G networks
Soon extending to **5G**



LoRaWAN™ Technology



LTE-M Technology

We aim to develop a catalogue of networks that will cover over 99% of our customer's needs, including public and private networks.

Additional technologies for IoT: WiFi, Bluetooth, ZigBee, satellite

We facilitate the work on

Standardization

Roaming

Interoperability

Coming next:

Enhancing the IoT with Edge computing & slicing

Edge Computing

- End-to-end latency
- data computed locally
- Intensive usage

5G

Slicing

Slicing is a new major enabler enhancing 5G with the ability to segment physical networks into logical networks (slices).



VPN Management

PMR private networks

Cloud solutions

Orange Valencia Trial

Platforms & IoT Ecosystem



We are adapting to customer maturity levels by proposing step-by-step IoT solutions

Provide IoT connectivity

- Address connected devices base,
- Enrich our network services

Provide IoT services

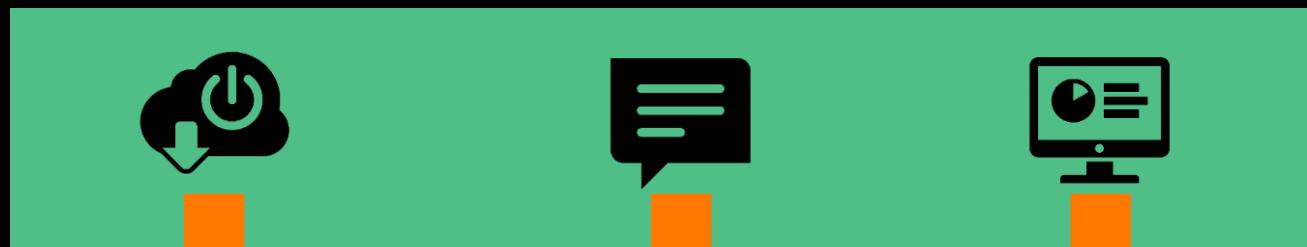
Live Objects

- Multi-connectivity Mgt
- Device/Fleet Management
- Data management, storage, advanced services
- Public APIs

Offer IoT Applications & Services

- Packaged business services
- End-to-end integration
- Professional services, Consulting - business transformation
- Partnerships/ecosystem
- Service Editors
- IT Integrators
- Cloud offers
- Device distribution

Live Objects, a easy-to-use and resilient IoT platform on top of connectivity, open to the IT ecosystem



Addressing different types of verticals

Device management

- Provisioning
- Configuration changes
- Sending commands

Message management

- IoT networks (2/3/4G, LoRa®*, LTE-M, NB-IoT)
- Collection in real time
- Security

Data management

- Data visualization
- Compatible with third-party dashboards
- 1 year storage

IoT device management, Enriched data collection, with connectors & tools for clouds and integrators (ESV), Simplified and resilient multi-connectivity

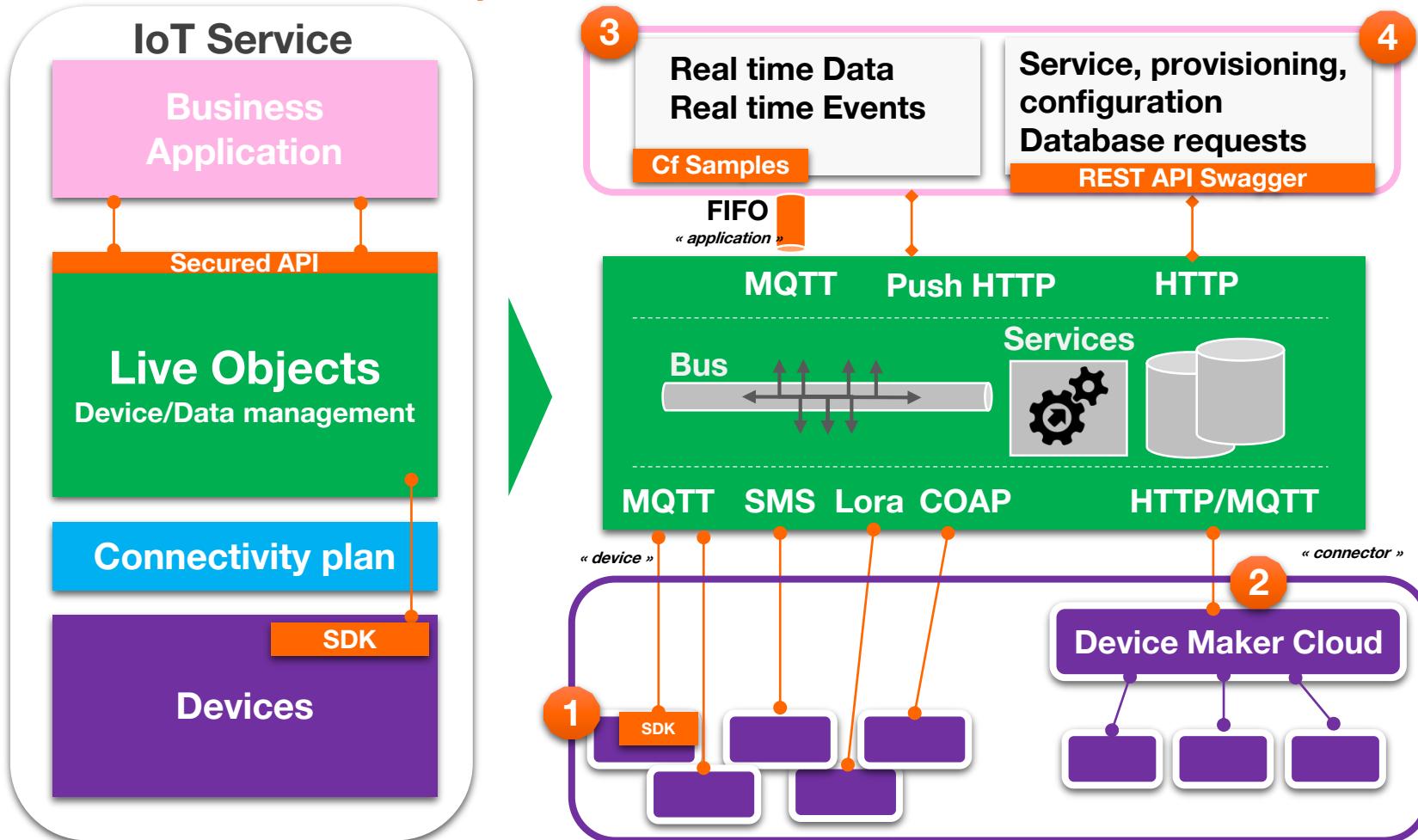
Smartcities

Industries

Agriculture

...

Live Objects: APIs and technical focus



Our key transversal priorities



Orange provides end-to-end security along the entire IoT value chain

Security by Design

Security by Operation



IoT security guidelines



Connectivity

LoRa, LTE-M, 



Network standardisation,
Audit, Cryptographic analysis



Objects

B2B & B2C

Security guidelines through our
OGDR, Assessment process...



Platforms & offers

Live Objects, Smarthome,
Smart Tracking, Thing'in

Security and Privacy by
Design process

And to achieve our ambition, we have identified strategic topics to be addressed in the coming years



AI & IoT

- ▶ For a more efficient data analysis and to improve customer experience

Security & IoT

- ▶ To build trust, implement appropriate standards and develop a cybersecurity promise for IoT

IoT & ecosystem

- ▶ To explore new developments like physical indexing, with the Thing'in platform

Thing'in, an open platform as a catalyst for the emergence of a graph-centric vision of the web of things



An open multi-sided research platform to fuel innovations in **Web of Things** technologies, usages/services and business models



A graph-centric Web of Things platform comprising

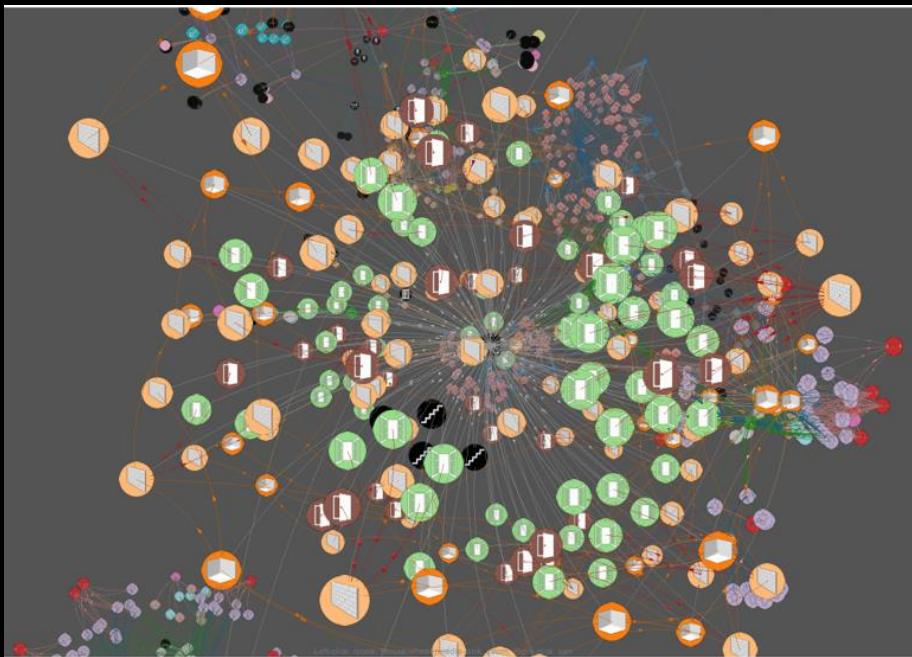


An in vivo experimentation platform

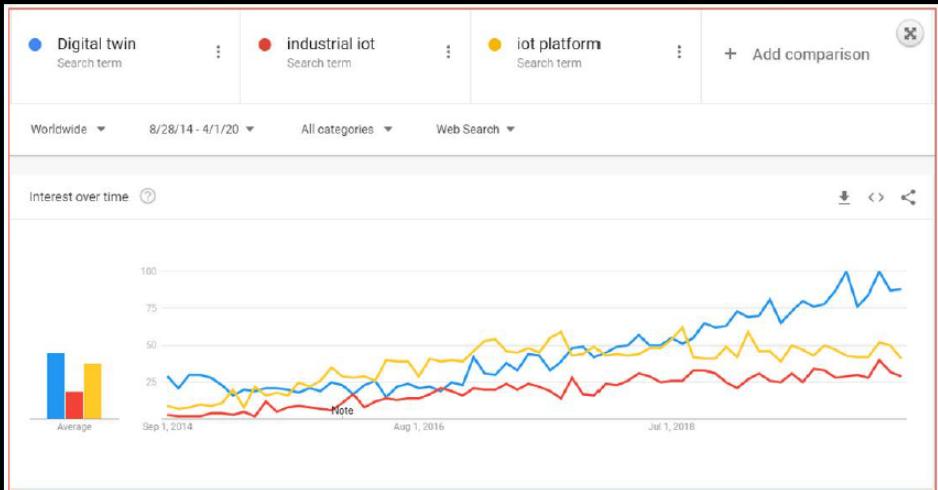
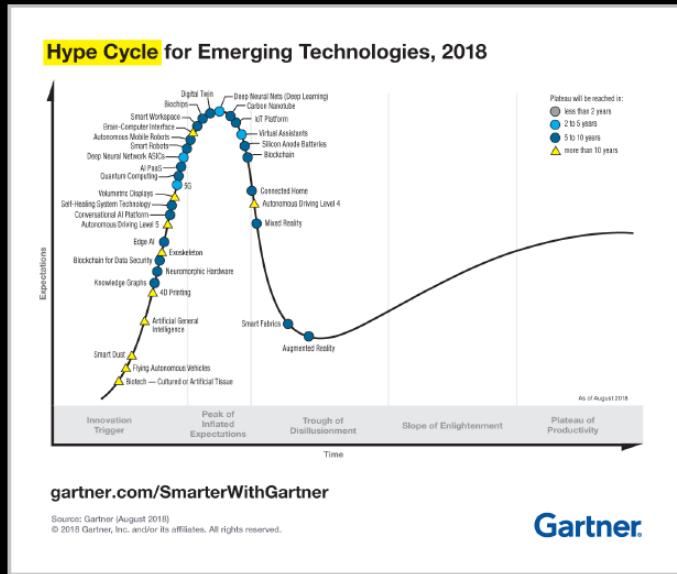


...where users define their security rules and other access modalities

Beyond the IoT with Digital Twins: Thing in the future

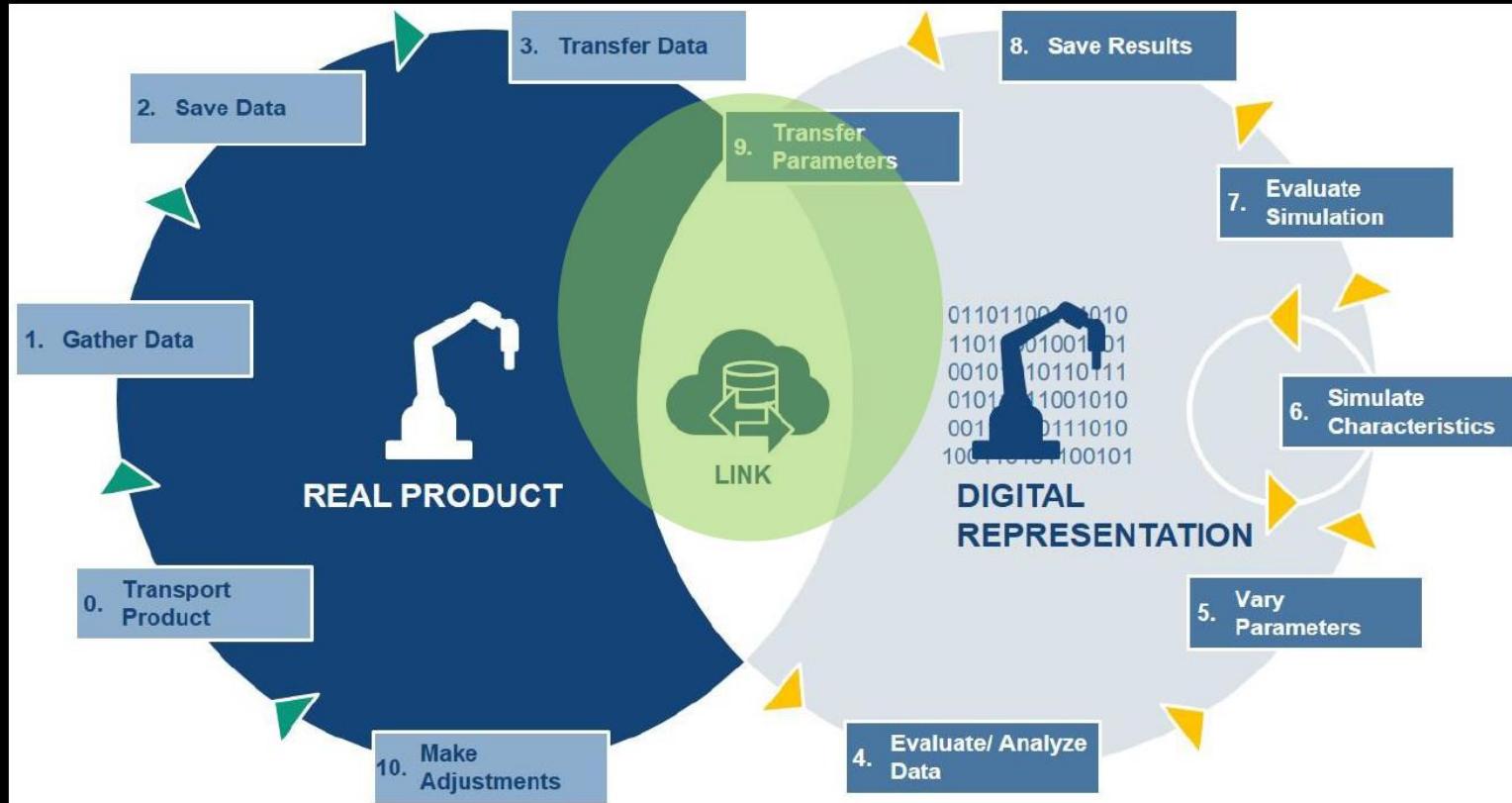


Digital Twin is the “next big thing” (Gartner, Google Trend)

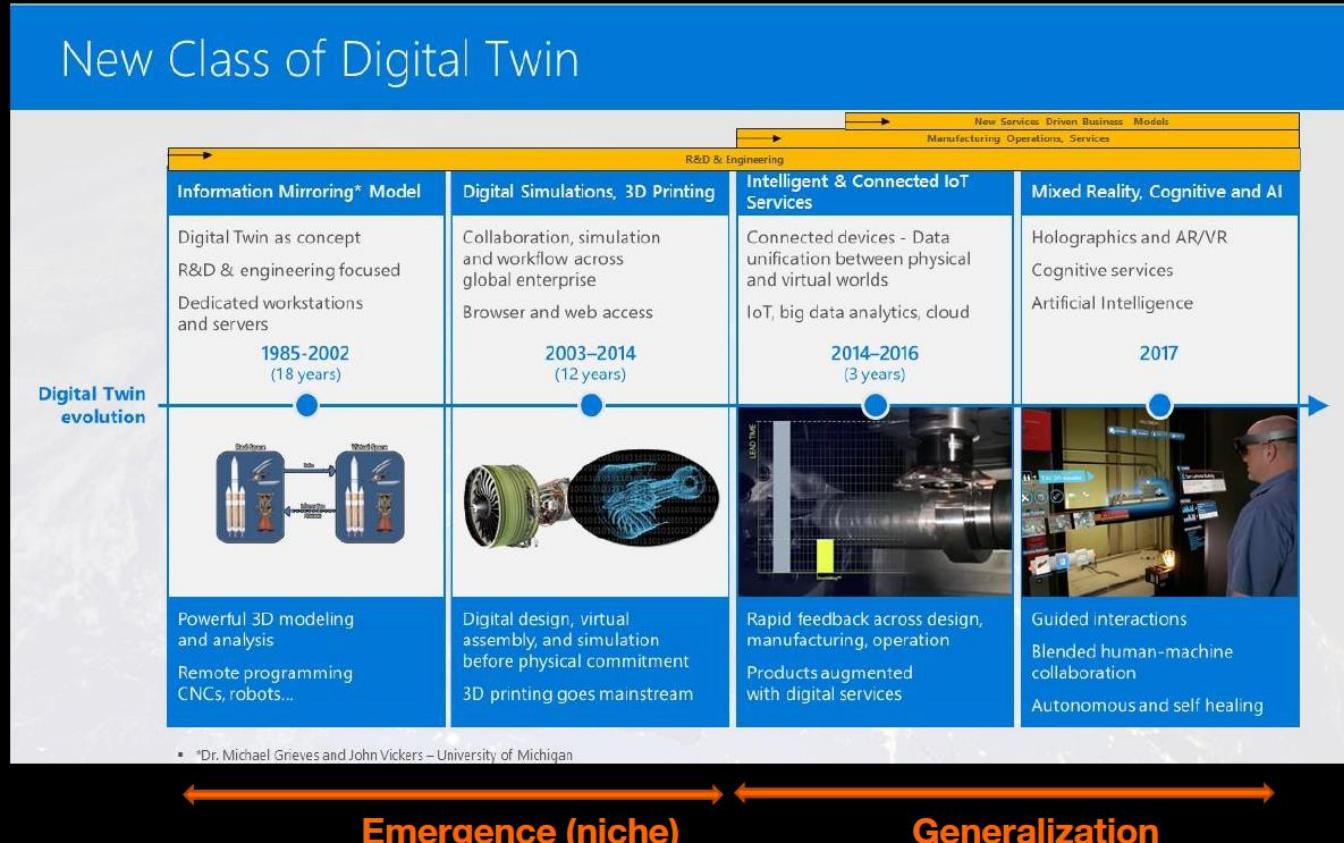


“The rise of digital twins coincides with the rise of the IoT.” Gartner

Definition/Features of Digital Twins



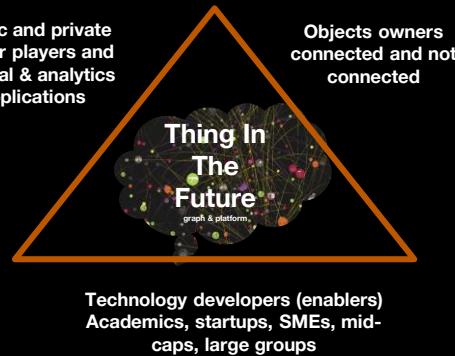
From “niche” to generalization with the IoT



Behind Thing in the future, lies a vision

Breaking the silos to foster new services

- the Internet is gradually encompassing objects in the **physical world** mirroring a massive deployment of connected objects (Internet of Things), most often administered in **closed and heterogeneous ecosystems**.
- sharing digital twins **within one graph** or across a **federation of interoperable graphs** makes it possible **to break the silos** and to foresee the development of **new services** with applications for territories, building management, logistics flows, the industry, the environment...
- driven by values of openness and collaboration, Thing In The Future is a **multi-sided platform** for stakeholders interacting within one or several ecosystems.



The Thing In The Future graph

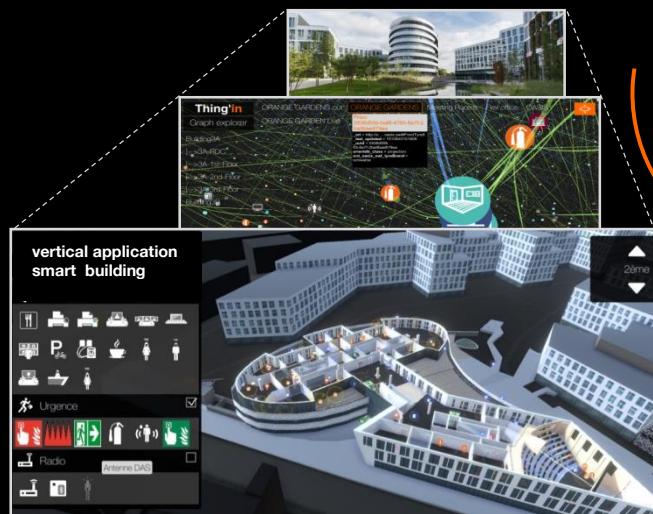
It is an **online open and secure graph of digital twins** of the physical world

- their properties (function, model, state, location...),
- their relationships (is adjacent to, is part of, is the sensor for, acts on, is compatible with...) that conveys **contextual information**,
- the access modalities (example: link to the API which allows access to data from a connected device).



Fostering new services

sharing **digital twins** between stakeholders to improve the management of buildings, of logistic chains, the efficiency of factories from an operational or energy perspective. Each stakeholder can enrich the graph therefore increasing its overall value.



within geographic territories

for verticals within ecosystems

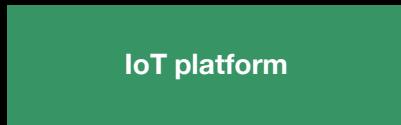


IoT platform & Analytics synergies

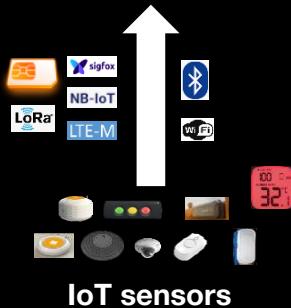
Vertical application



↑ API



IoT platform



Values reported by the sensors (here the temperature)

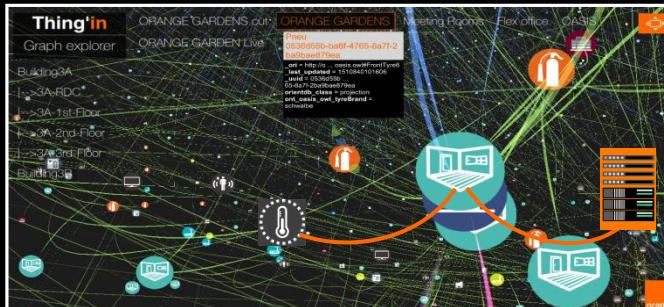


Vertical application / **analytics** processing of data collected by the IoT platform complemented with information on the physical environment



↑ Connected devices and their physical environment (**contextual information**)

Connected devices and their physical environment modeled on the Thing In The Future graph



32°



Thing in the future and Live Objects

Two complementary platforms

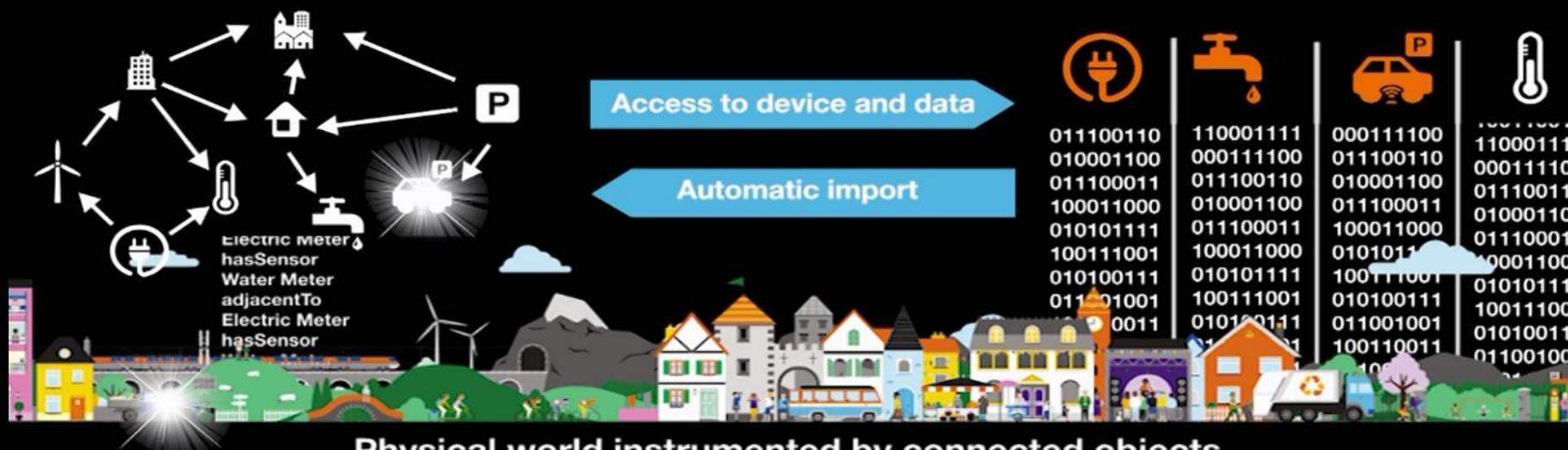
Thing in

A digital twin of physical world which
links connected and unconnected objects
Fuel interactions between actors

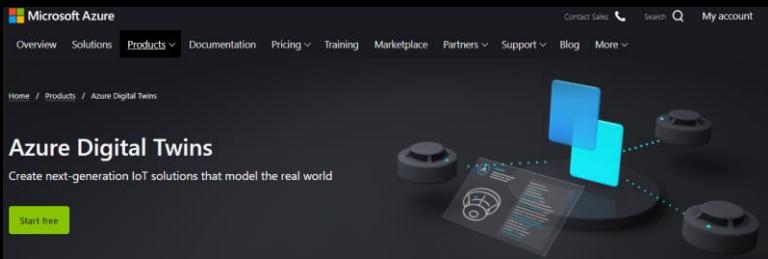
Advanced services

Live Objects

Manage connected objects and data
for any connectivity
Enable interactions per customer



Digital Twin trends in IoT ecosystem



Microsoft Azure

Overview Solutions Products Documentation Pricing Training Marketplace Partners Support Blog More

Contact Sales Search My account

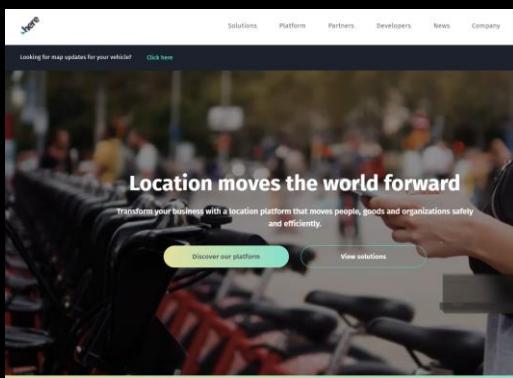
Home / Products / Azure Digital Twins

Azure Digital Twins

Create next-generation IoT solutions that model the real world

Start free

The landing page for Microsoft Azure Digital Twins. It features a dark background with a central image of a smartphone connected to a circular interface showing data, surrounded by small IoT devices. The Microsoft logo is at the top left, and a navigation bar with links like Overview, Solutions, Products, Documentation, Pricing, Training, Marketplace, Partners, Support, Blog, and More is at the top. Below the navigation is a breadcrumb trail: Home / Products / Azure Digital Twins. The main heading is "Azure Digital Twins" with the subtext "Create next-generation IoT solutions that model the real world". A green "Start free" button is at the bottom left.



Looking for map updates for your vehicle? [Click here](#)

Solutions Platform Partners Developers News Company

Location moves the world forward

Transform your business with a location platform that moves people, goods and organizations safely and efficiently.

[Discover our platforms](#) [View solutions](#)

The Jero website features a large image of a person using a mobile device to view a map. The main headline is "Location moves the world forward" with the subtext "Transform your business with a location platform that moves people, goods and organizations safely and efficiently.". It includes two buttons: "Discover our platforms" and "View solutions". The top navigation bar includes links for Solutions, Platform, Partners, Developers, News, and Company. A call-to-action button "Click here" is located above the navigation.



ditto

... where IoT devices and their digital twins get together

The ditto website features a large, stylized blue "C" logo composed of a 3D grid. Below the logo is the word "ditto" in a bold, lowercase sans-serif font. A tagline "... where IoT devices and their digital twins get together" is centered below the logo. The background is white.



SHODAN

Explore Pricing Enterprise Access

New to Shodan?

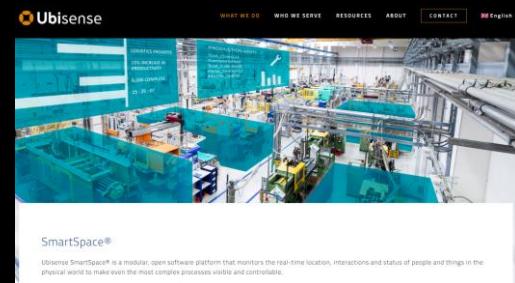
The search engine for Buildings

Shodan is the world's first search engine for Internet-connected devices.

Create a Free Account Getting Started

67.20.69.105
50.67.75.184
104.16.61.231

The Shodan website features a search bar with the Shodan logo. The top navigation bar includes "Explore", "Pricing", and "Enterprise Access". A "New to Shodan?" link is in the top right. The main headline is "The search engine for Buildings" with the subtext "Shodan is the world's first search engine for Internet-connected devices.". It includes two buttons: "Create a Free Account" and "Getting Started". Below the headline is a globe with numerous red dots representing connected devices, with some IP addresses listed: 67.20.69.105, 50.67.75.184, and 104.16.61.231.



A few applications



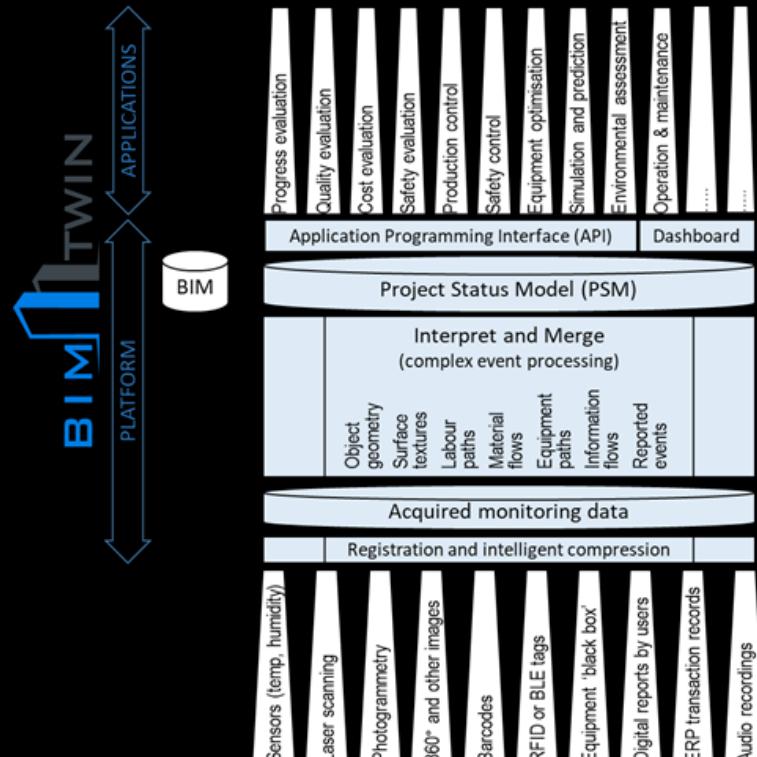
BIM2TWIN: Optimal Construction Management & Production Control

Provide a real-time status of a construction site through a Digital Building Twin (DBT)

- Progress, quality of work
- Location of workers, equipments, materials
- Safety conditions

DBT enables a Project Status Model (PSM) with meaningful information

- “As built” view (physical status of the building) compared to “As designed” view from building design (BIM – Building Information Model)
- “As performed” view (status of the construction process) compared to “As planned” view from building design (BIM)
- Identification of divergence, understanding the reasons, how to avoid them
- Past status (one) and simulation of future status (several)



Incident handling (smart city)



The town hall of a city focused on the well-being of its citizens wishes to develop a way to allow them to signal and alert on the objects of the city (street lamps no longer lighting, dirty benches, glass breakage, ideas and opinions on improvements), but the silo governance of these objects by different stakeholders (city, region, companies) slows down the development of cross vertical services.

The integration of GIS data from these different actors (objects in public space) into Thing In The Future should allow to direct the message from the passer-by to the right administrator.

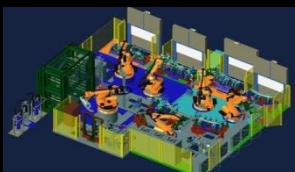
Proof of Concept with the city of Meylan

Industry

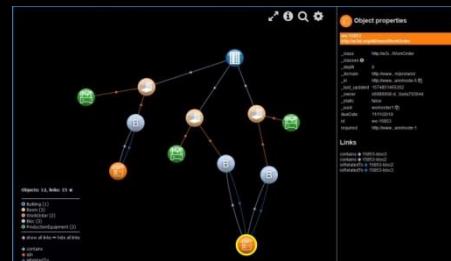
On the Way to the digital twins...



Around Thing in is a set of **enablers & analytics** based on the graph such as **Virtual Reality simulations**, **preventive & predictive maintenance** and **Augmented Reality services**



With the BIM, the factory is represented with its objects such as products, tools, machines, robots...



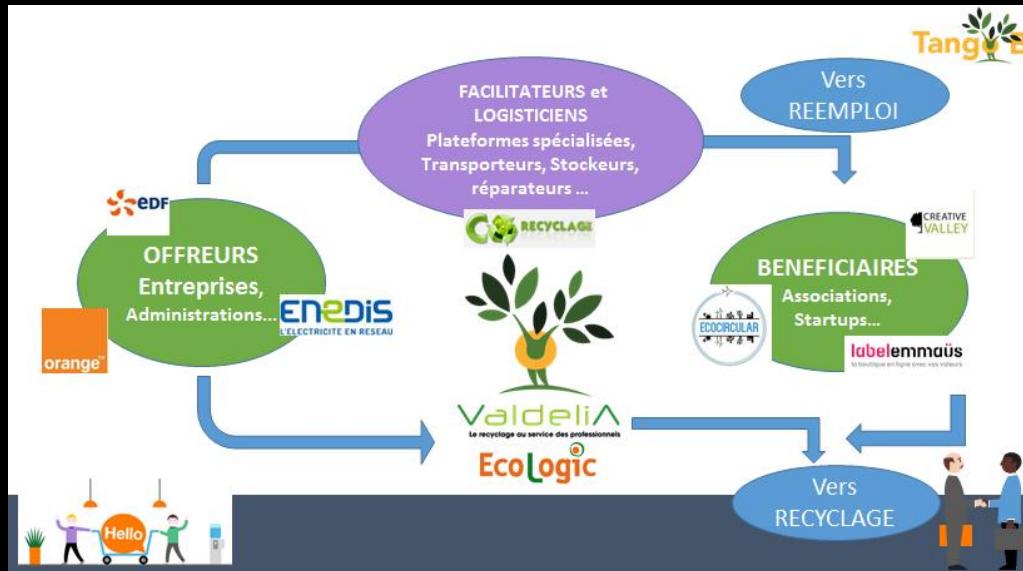
The Thing in graph helps **locate and track** the objects, including IoT sensors, on the production line. Thing in provides useful **contextual information** to the **many stakeholders** involved in the process.

They can therefore follow the **production process** and review it afterwards using the **history** function.

Thing in is central to transform the factory production process by replacing repeated controls by human intervention

EMC2 research collaborative program

Circular economy



Simplify and secure the re-use of goods and materials from companies and administrations so that re-use becomes more natural than throwing away.

Builds on Thing in as a universal object directory.

Supported by ADEME.



Research collaborative program

Logistics



Optimizing the supply chain: better suitability for container / content with applications such as sharing trucks capabilities between the many logistics companies. This would be very useful as many containers after unloading remain empty.

**Physical Internet MinesParisTech
chair with Orange involvement in
logistics**

Thing In The Future is an open & experimental platform

Thing In The Future is available:

- through a public portal for the overall presentation
- through an access dedicated for users, object owners, application developers, technology developers

To open an account: <https://tech2.thinginthefuture.com/signup>

Demo

Thanks



Appendices

Plug'in

Ambient connectivity

Soon, ambient connectivity will become almost as important as the air we breathe



Prepare for ambient connectivity through an environment of virtualised networks functions software development and an autonomous and high-performance network management centre

Thing'in Internet of Things

At present, connected objects are limited to the applications upon which they depend. In the future, they will link up with other objects and users.

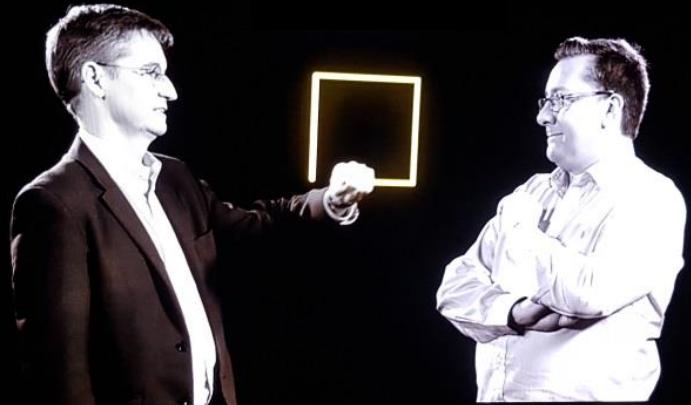


Build the cornerstone of the Internet of Things: indexation and search engine to discover objects, operation and enhancement of the relationships between objects

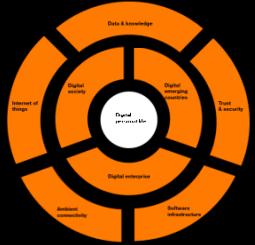
Home'in

Sensitive home

Ambient connectivity, connected objects and artificial intelligence will revolutionise our everyday life at home

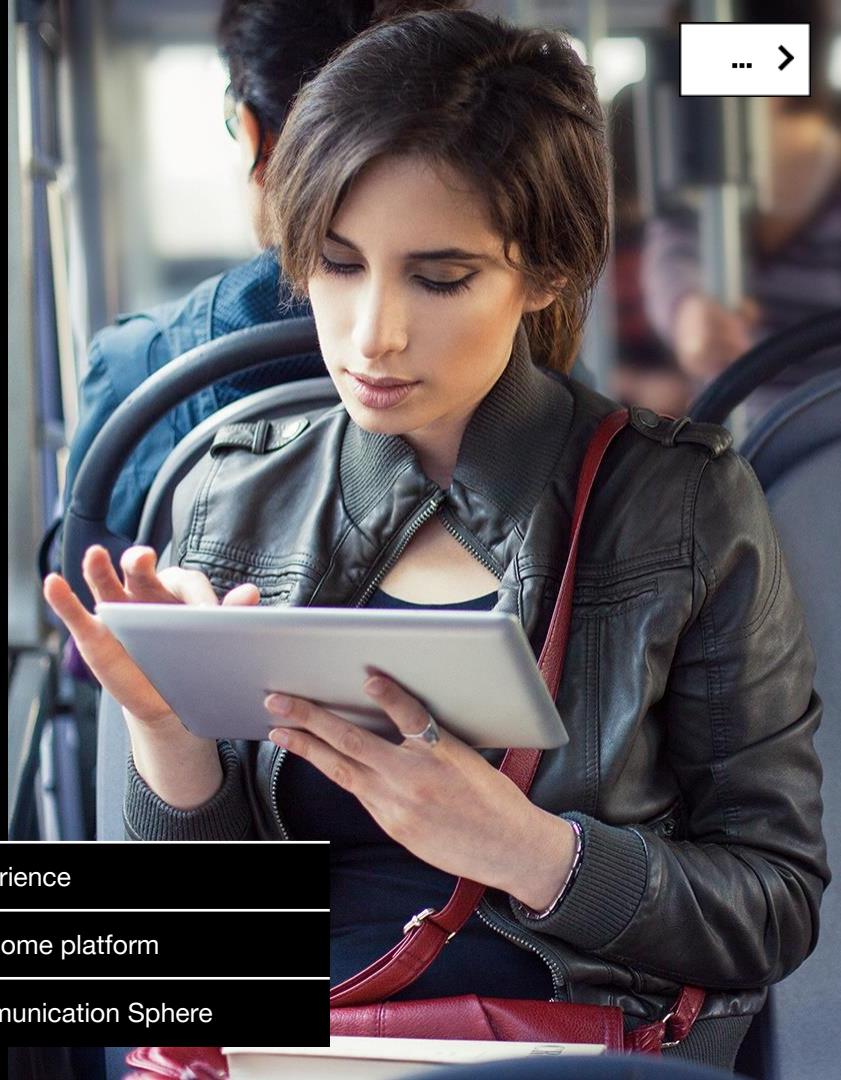


Design our intelligent and sensitive home which will protect our private lives and enable new opportunities: an experimental house, an open and interoperable environment, a common architecture

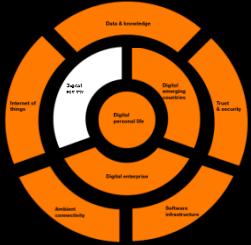


Digital personal life

Identify emerging usage patterns and design new, enhanced production, management, and digital content services as part of a more interactive and immersive communication experience

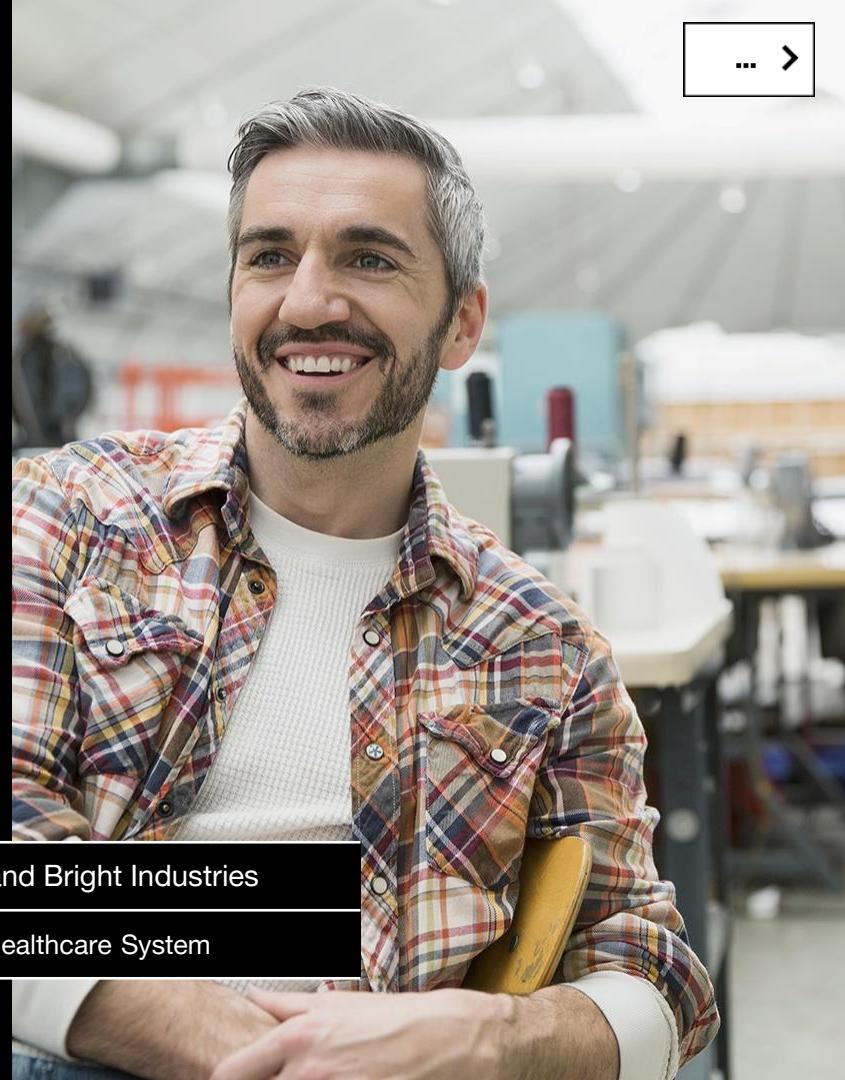


| | |
|-------------------------------------|--------------------------------------|
| Digital Me | Enhanced Home Experience |
| Collaborative Innovation and Design | Ubiquitous data and Home platform |
| Augmented Comms and Memories | Transaction and Communication Sphere |



Digital society

Design a renewed society, from education to health, from nomadism to connected transport, from our civil life to future industry, progressively and profoundly transformed by digital technology became a fully fledged social challenge



| |
|---|
| Transforming Society & Digital Humanities |
| Interconnecting Attractive Territories |
| Modelling Human Cities |

| |
|-------------------------------------|
| Smart Farming and Bright Industries |
| Design a Digital Healthcare System |





Digital emerging countries

Establish digital ecosystems adapted to challenges and constraints in developing countries in order to offer accessible connectivity to as many people as possible, as well as services adapted to local needs and compatible with available infrastructures



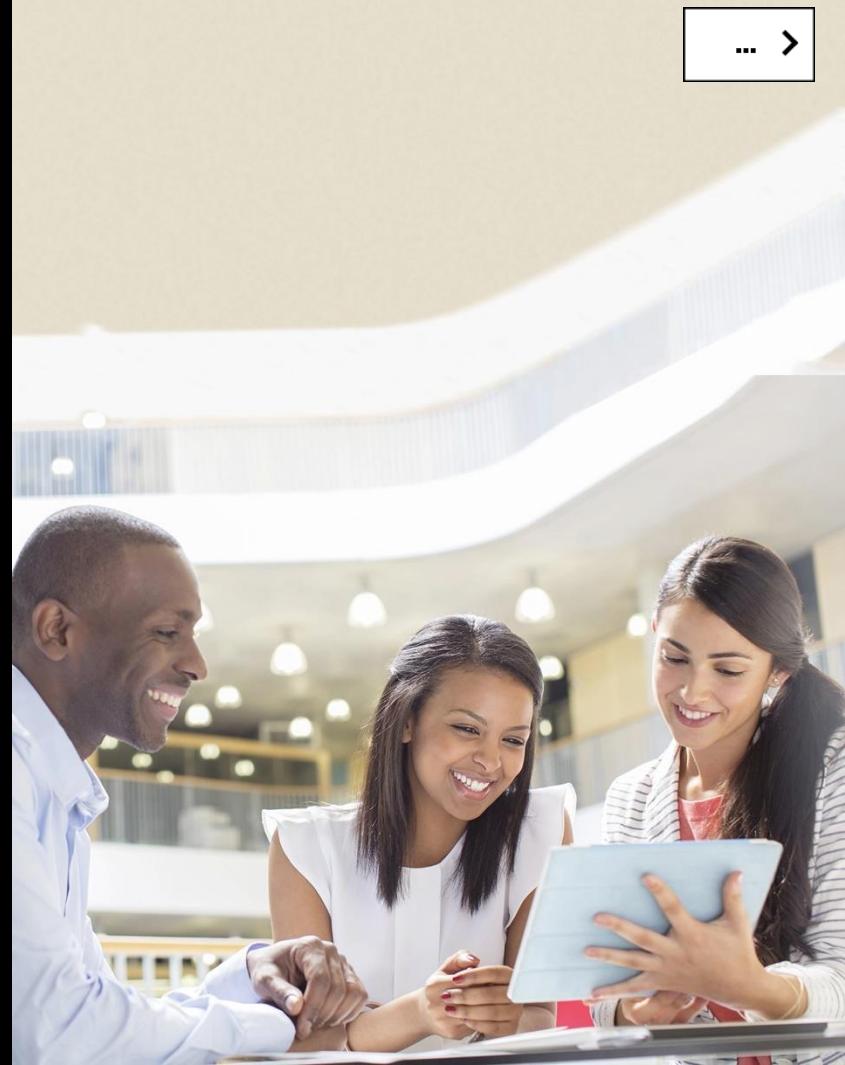
| | |
|---|--|
|  New Growth Opportunities for AMEA |  Usable Applications |
|  Emerging countries designed services |  Emerging countries infrastructures & enablers |

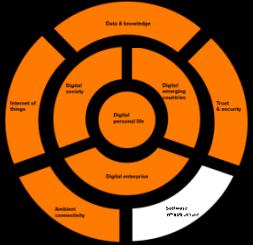


Digital enterprise

Support enterprises' digital transformation, so that it will be human-oriented, responsible and efficient, through study tools, agile, cooperative and empowering organisational structures and operating methods

| | | | |
|--|--------------------------|--|-------------------|
|  | Emerging Ways of Working |  | Entreprise 4.0 |
|  | Smart Working |  | Customer relation |





Software infrastructure

Manage IT and telecom convergence, the profound transformation of networks, the cloud and IT systems

Design a distributed “clouds and networks” software infrastructure and its operating environment to enable new services and businesses to emerge



| | |
|----------------------------------|--------------------------------|
| One Cognitive Operation | Network & Service Architecture |
| Distributed IaaS | Cross-Layer & QoE |
| Telco PaaS & Software Techniques | Plug'in – In Vivo Research |





Ambient connectivity

Use our ecosystems to design future networks and economic models that will provide ambient, cost- and energy efficient connectivity that is also a source of value creation

| | |
|---------------------------------------|--|
| Green Everywhere | |
| Optical Networks | Massive IoT Connectivity |
| Wireless Broadband Everywhere | Local Network |
| RAN Design and Critical Communication | Connectivity and Infrastructure Business |





Internet of Things

Participate in the emergence of software platforms and languages open to our ecosystems, allowing massive interaction between objects from different spheres (personal, home and city, industry and business, car and transport objects, etc.), between objects and services, between humans and the Internet of Things



Fog Computing

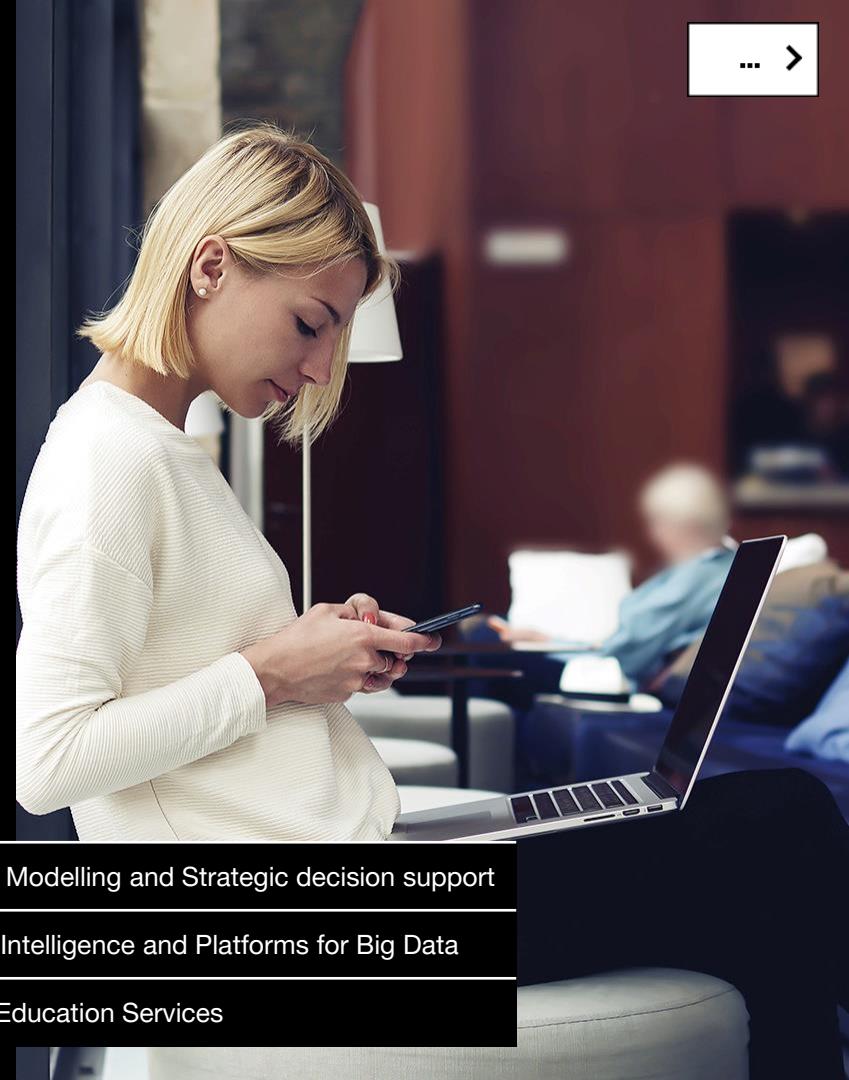
Cyber Physical Interaction

Smart Object Management



Data & knowledge

Develop algorithms, technical building blocks and platforms compatible with Big Data and for artificial intelligence



| | |
|---|---|
| Future Technical Chain for Audiovisual Services | Tools for Economic Modelling and Strategic decision support |
| Recognition in Audio-visual Content | Data management, Intelligence and Platforms for Big Data |
| Operations Research and Data Analytics | New Information & Education Services |



Trust & security

Research new, trusted architectures that are proven to be secure, capable of protecting personal data and enriched through usage

| | |
|--|---|
|  | Protection and Control of Personal Data |
|  | E2E security and dependability |
|  | Trusted Cloud |

| | |
|--|-------------------------------------|
|  | Security Management |
|  | Identity Based Trusted Architecture |

